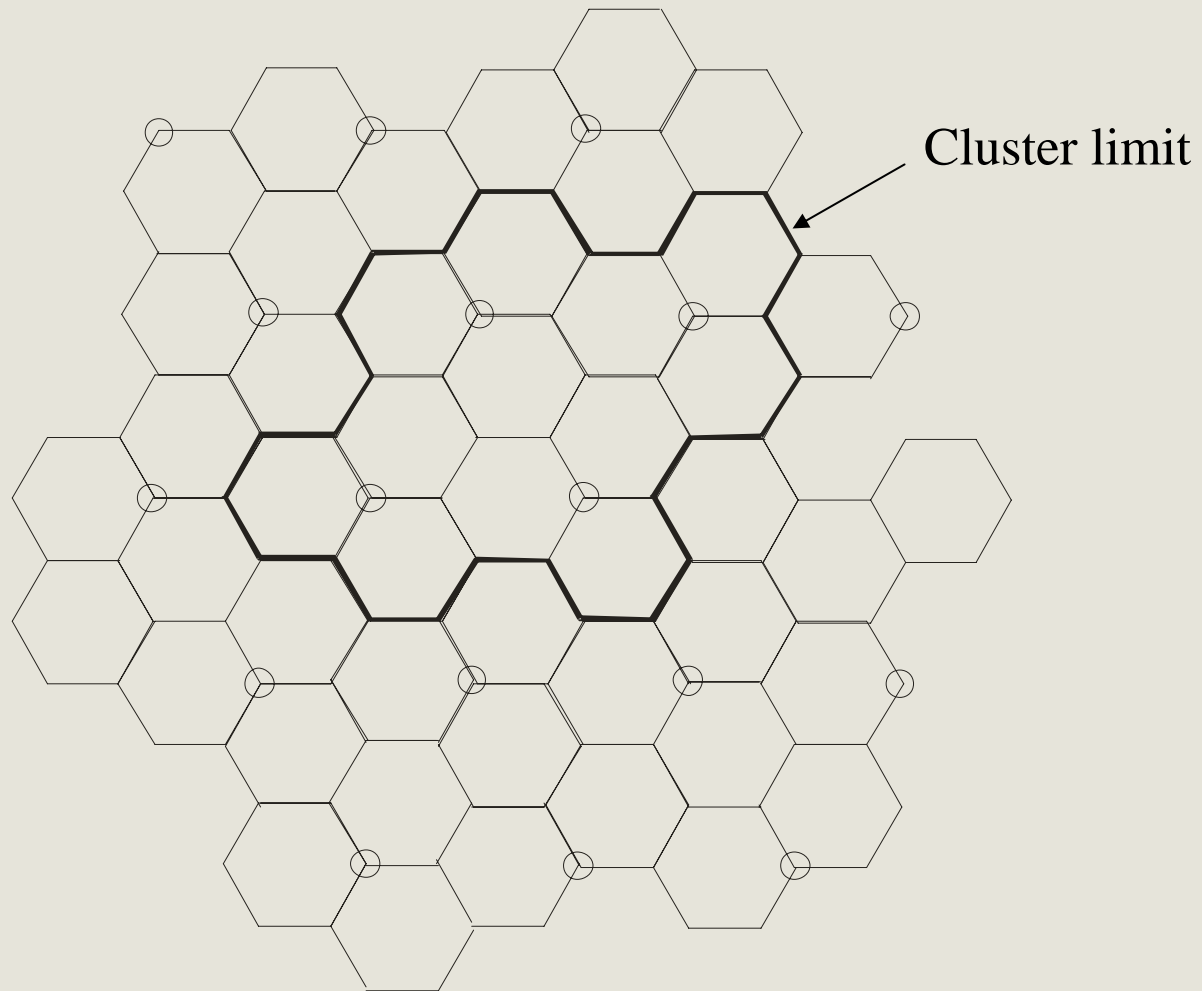


Frequency use in GSM



Frequency use in GSM

- All frequencies in an operator's band may be used within a cluster. Outside the cluster, the frequencies are reused. For example, 5 MHz means 24 carrier frequencies are available for allocation in a cluster.
- For GSM, each cell needs at least one carrier at constant power (determining the cell size) as a common "beacon" (broadcast channel) for measurements, cell-ID, and other common control information. The remaining part of this carrier is used for traffic.
- In rural areas, it is sufficient to use just a "beacon" carrier.
- For acceptable operation, GSM requires 12 frequency reuse distance. Using 5 MHz as an example, it is only possible to use two carriers in each cell ($24:12=2$), of which one is the "beacon" carrier. "12 reuse" means that there is $12 \times 200 \text{ kHz} = 2400 \text{ kHz}$ between the carriers. So, transmitting on two carriers at a constant maximum power will require 2.4 MHz frequency separation.
- In very "good" environment conditions, up to 9 frequency reuse is possible in some cells, *i.e.*, 1800 kHz between carriers (applies to non-"beacon" carriers only).
- To increase capacity further, normal reuse will require increased spectrum.

Frequency use in GSM

- If more traffic has to be handled, and thus more than one additional carrier is needed to increase capacity, but no more spectrum is available, then other techniques are necessary, including:
 - “Cell splitting,” *i.e.*, reducing cell size and adding more sites (thus reducing maximum power in the cell and increasing the cost of providing service);
or
 - Increasing spectrum efficiency by utilizing the statistical characteristics of traffic and user distribution to emulate tighter reuse for all the carriers except the “beacon” carrier, *e.g.*, silent periods (by DTX), output power regulation, frequency hopping, etc. This “fine tuning” operation can be attempted after the system is deployed. If tighter reuse is not possible, cell splitting can be implemented.

Frequency use in GSM

- Due to interference limitations and the limited capability of mobiles to handle co-channel collisions, use of tighter reuse (“1/1-reuse”) increases restrictions on the carriers carrying only traffic channels:
 - DTX, or frequency hopping over the whole available frequency block must be applied as much as possible to spread and level out any interference.
 - Output power regulation must be applied as much as possible. This will decrease the power by an average of 6 dB.
 - Each carrier cannot be used more than 25% of the time. This reduces average interference by an additional 6 dB.
 - Even in extreme cases (one “beacon”-carrier and two traffic-only carriers within 1 MHz), the carriers will not transmit more than 1.2 x maximum power per-carrier. Short peaks may occur where two carriers will transmit simultaneously at maximum output power in the cell within a 1 MHz band. If, in peak traffic, an additional carrier is present, the total power used by the carriers will still be less than for the 1+2 carrier case described above.